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The Effect of Vermicompost and NPK Fertilizer on Growth of Long Beans (*Vigna sinensis* L.)

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Abstract: Long beans are short-lived plants that are widely cultivated in Indonesia. To stimulate the growth of long beans, it is necessary to fertilize with the appropriate dose for its growth. Research on the effect of vermicompost and NPK fertilizer has been carried out in Mertak Umbak Village, Central Lombok. The purpose of the research was to determine the effect of the application of vermicompost on the growth of long beans, the effect of the application of NPK fertilizer on the growth of long beans and the interaction effect of the application of vermicompost and NPK fertilizer on the growth of long beans. The research was carried out with a 2-factor design and 4 replications. The research data were analyzed by analysis of variance. In this study, the results showed that the treatment of vermicompost significantly increased the number of leaves and plant height, but could not increase the length and width of the long bean leaves, the application of NPK fertilizer could increase the leaf length, leaf width, number of leaves and stem length of long beans and the interaction of vermicompost and NPK fertilizer treatment did not significantly affect all measured long bean growth parameters.

Keywords: Vermicompost; NPK fertilizer; Long Beans

Introduction

Long beans are short-lived plants that are widely cultivated in Indonesia. This plant has a long stem and twists objects around it. Long Bean Leaves are compound leaves where on each petiole 3 leaves are found. The roots have nodules that play a role in the process of fixing nitrogen free from the air. Long bean flower is a butterfly flower whose stems grow from the leaf axils. The fruit of this plant is a green pod (Haryanto et al., 2007). The edible part of the long bean is the fruit and its young leaves. Young leaves and fruit can be processed into a variety of dishes. The leaves and fruit contain many nutrients that are useful for human health. The young fruit contains a lot of minerals, vitamin A and vitamin B. Long bean seeds contain lots of protein, fat and carbohydrates. Minerals that can be found in long beans are calcium, phosphorus and iron (Asrifah, 2010).

To stimulate the growth of long beans, it is necessary to fertilize with the appropriate dose for its growth. At this time, people generally use NPK fertilizer. The use of chemical fertilizers such as NPK fertilizers has a negative impact on the environment. Purba et al. (2022) explained that the negative impacts of using chemical fertilizers and pesticides include decreasing soil fertility, increasing attack of nuisance organisms, a decrease in the population of microorganisms that are beneficial to plants and the occurrence of environmental pollution. Due to the negative impact caused by the use of chemical fertilizers, their use needs to be reduced through the use of a combination of chemical fertilizers and organic fertlizer.

Vermicompost is one of the organic fertilizers that can be used in plant cultivation. Khairani et al. (2010) explained that vermicompost treatment can increase the availability of nitrogen nutrients in the growing media. Likewise, Sinda et al. (2015) reported that the application of vermicompost can increase the percentage of N-total soil, the amount of P-available in the soil and the C-organic content of the soil. In addition, the application of vermicompost can also increase soil pH and the number of microorganism populations in the soil. The higher the

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dose of vermicompost up to a dose of 20.00 tons per hectare, the higher the nutrient content in the soil, the total papulation of soil microorganisms and the yield of mustard greens up to 35 tons per hectare.

In an effort to reduce the use of chemical fertilizers, a study was conducted on the effect of vermicompost and NPK fertilizer on the growth of long beans. The purpose of the research was to determine (1) the effect of vermicompost application on long bean growth, (2) the effect of NPK fertilizer application on long bean growth, (3) the interaction effect of vermicompost and NPK fertilizer application on long bean

Method

The research was carried out from April to August 2022 in Mertak Umbak Village, Praya District, Central Lombok. The materials used are: vermicompost, long bean seeds, paddy field soil, bamboo stakes, rapia rope, NPK fertilizer. Insecticide pastec 15 EC, and water. Furthermore, the tools used include: hoe, sickle, machete, plastic bucket, water pump machine, water hose, handsprayer, hammer, push artco, scales and saw.

The stages of carrying out the research were: (1) removing weeds at the research site using a sickle, (2) cultivating the soil at the research site using a hoe, (3) at the research site making beds that extend in a north-south direction, (4) sprinkling vermicompost on the site research and mixing vermicompost with soil until evenly mixed, (5) planting long bean seeds at the research site, (6) irrigating the plants periodically once in 12 days (7) measuring the growth parameters of long bean, (8) analyzing research data.

The research was carried out with a 2-factorial design, the first factor was the application of vermicompost and the second factor was the application of NPK fertilizer. the application of vermicompost consists of 4 levels, namely: C0 = treatment of 0 kg vermicompost, C1 = treatment of 0.8 kg vermicompost, C2 = treatment of 1.6 kg vermicompost and C3 = treatment of 2.4 kg vermicompost. NPK fertilizer application consists of 4 levels, namely P0 = treatment of 0 g of NPK fertilizer, P1 = treatment of 0.5 g of NPK fertilizer, P2 = treatment of 1 g of NPK fertilizer, P3 = treatment of 1.5 g of NPK fertilizer, Measurement of long bean plant growth parameters was carried out when the plant was 30 days old which included number of leaves, leaf length, leaf width and plant length. Growth parameter data were analyzed by Anova test (Toutenburg and Shalabh, 2009).

Result and Discussion

Long Bean Leaf Number

The amount of vermicompost and NPK fertilizer used in plant cultivation can determine the availability of nutrients in agricultural land. Therefore, the dose of vermicompost and NPK fertilizer applied also affects the rate of plant growth. In table 1, the average number of long bean leaves is presented due to different doses of vermicompost and NPK fertilizer

Table 1. Average Number of Long Bean Leaves Due to Differences in Dosage of NPK and Vermicompost Fertilizer

Treatment	Leaves Total	Treatment	Leaves Total
C0P0	21	C2P0	22
C0P1	22	C2P1	23
C0P2	22	C2P2	26
C0P3	21	C2P3	25
C1P0	21	C3P0	21
C1P2	22	C3P1	22
C1P2	23	C3P2	23
C1P3	23	C3P3	23

Table 1 can be observed that the lowest total leaf at 30 days of age was 21 leaves obtained in the C0P0 treatment, namely plants growing on land treated with 0 kg of vermicompost r and 0 kg of NPK fertilizer. Furthermore, up to a dose of 1.6 kg of vermicompost and 1 g of NPK fertilizer, the number of long bean leaves increased in line with the increase in the dose of vermicompost and NPK fertilizers. The highest mean number of leaves was 26 leaves obtained in the C2P2 treatment, namely the application of 1.6 kg of vermicompost combined with 1 g of NPK fertilizer.

The results of the analysis of variance showed that the vermicompost treatment significantly increased the number of long bean leaves. Application of NPK fertilizer can significantly increase the number of long bean leaves. The interaction of the dose of vermicompost and NPK fertilizer had no significant effect on the number of long bean leaves. The increase in the number of long bean leaves due to the application of vermicompost is possible because the vermicompost contains nutrients needed by plants. Based on the results of laboratory tests that the macronutrient content in vermicompost reaches the minimum nutrient content requirements in solid organic fertilizers determined by the Indonesian government (Lokha et al., 2021). Sinda et al. (2015) reported that the application of vermicompost can increase the percentage of N-total soil, the amount of P-available in the soil and the C-organic content of the soil. In addition, the application of vermicompost can also increase soil pH and the number of microorganism populations in the soil. The higher the application of vermicompost fertilizer up to a dose of 20.00 tons per hectare, the higher the nutrient content in the soil, the total papulation of soil microorganisms and the yield of mustard greens up to 35 tons per hectare. Likewise, Khairani et al. (2010) explained that vermicompost treatment can increase the availability of nitrogen nutrients in the growing media.

Research whose results are in line with this study, among others, Wahyudin and Irwan (2019) reported that vermicompost fertilizer treatment was able to increase the number of plant leaves. In addition, the application of vermicompost can also increase plant height, wet weight and dry weight of mustard plants. Research by Nurdiana et al. (2019) showed that the application of vermicompost can increase the number of leaves, plant height and wet weight of shallot plants. Likewise, Raksun et al. (2021) found that the use of vermicompost fertilizer significantly increased the number of leaves, stem height, leaf length, leaf width and stem diameter of green eggplant plants. The best dose of vermicompost for green eggplant is 18 tons per hectare. In other plants it was found that treatment of vermicompost of 1.8 kg resulted in the best stem diameter, number of compound leaves, leaf length, and stem height of tomato (Raksun et al., 2021). The application of vermicompost significantly increased the number of leaves and plant height of phaseolus vulgaris (Raksun et al., 2022). Vermicompost application had a significant effect on leaf number, leaf length, leaf width, stem hight and stem diameter of spinach (Raksun et al., 2022). Vermicompost with recommended doses of chemical fertilizer was suitable for the improved growth and yield of cabbage (Ali and Kashem, 2018).

Long Bean Leaf Length

Data collection on the length of long bean leaves was carried out when the plants were 30 days old. Variations in doses of vermicompost and NPK fertilizers resulted in variations in the length of long bean leaves. In table 2, the data on the results of measuring the length of the long bean leaves are presented when the long beans are 30 days old.

Table 2. Mean leaf Length of long beans at different doses of NPK fertilizer and Vermicompost

Treatment	Leaf Length (mm)	Treatment	Leaf Length (mm)
C0P0	128	C2P0	128
C0P1	132	C2P1	130
C0P2	134	C2P2	135
C0P3	129	C2P3	134
C1P0	128	C3P0	128
C1P2	132	C3P1	130
C1P2	135	C3P2	133
C1P3	134	C3P3	132

Table 2 can be seen that the highest average leaf length of long beans was 135 mm which was obtained from plants treated with 1.6 kg of vermicompost and 1 g of NPK fertilizer. The lowest leaf length was 128 mm found in the combination treatment of 0 kg vermicompost and 0 gram NPK fertilizer. In addition, the lowest long bean leaf length was also found in the treatment of 0.8 kg, 1.6 kg and 2.4 kg of vermicompost combined with 0 grams of NPK fertilizer

Analysis of variance gave the result that the different doses of vermicompost had no significant effect on the length of the long bean leaf. Application of NPK fertilizer can increase the length of long bean leaves. The interaction of vermicompost application and NPK fertilizer had no significant effect on long bean leaf length. The increased length of long bean leaves due to the application of NPK fertilizer is possible because NPK fertilizer containing nitrogen, phosphorus and potassium. Lingga (2002) explained that plant metabolism is determined by the availability of nutrients, especially nitrogen, phosphorus and potassium which play an important role in the vegetative and generative growth phases. Likewise, Sutejo (2008) explained that NPK fertilizer contains nitrogen which functions to increase plant vegetative growth. Furthermore, Mansyur et al. (2021) explained that nitrogen plays a role in the preparation of amino acids, proteins and fats, constituent of leaf chlorophyll which is important in the photosynthesis process, stimulates vegetative growth and tillers. Thus, sufficient amounts of nitrogen, phosphorus and potassium can stimulate the elongated growth of long bean leaves.

Research on other plants gave similar results to this study. Application of N, P and K fertilizers can increase leaf area index, number of leaves, plant height, yield, number of productive branches, and stem diameter (Firmansyah et al., 2017). Furthermore, Adnan et al (2015) reported that the application of 142 g of NPK fertilizer could increase the length of the midrib of the seedlings, the dry weight of the crown and the dry weight of the roots of oil palm. Treatment of 300 kg of NPK per hectare combined with 10 tons of cow dung can increase the number of panicles, panicle grain weight and grain weight per hectare of sorghum plants (Muis et al, 2018). NPK fertilizer treatment can increase plant height, number of leaves, leaf area, chlorophyll content, wet weight and dry weight of bok choy (Kurnianta et al, 2021). NPK fertilizer can increase number of leaves, leaf length, stem hight and stem diameter of sweet corn (Raksun et al., 2021)

Long Bean Leaf Width

The data of long bean leaf width measured when the long beans were 30 days old showed a difference according to the weight of the vermicompost and NPK fertilizer applied. Long bean leaf width increased up to the treatment of 1.6 kg of vermicompost and 1 gram of NPK fertilizer. In Table 3, complete data on the mean leaf width of long bean are presented in each treatment combination

Table 3. Mean leaf width of long beans at different doses of NPK fertilizer and Vermicompost

Treatment	Leaf Width (mm)	Treatment	Leaf Width (mm)
C0P0	69	C2P0	69
C0P1	70	C2P1	70
C0P2	74	C2P2	74
C0P3	73	C2P3	73
C1P0	70	C3P0	69
C1P2	70	C3P1	70
C1P2	74	C3P2	73
C1P3	72	C3P3	72

The data in Table 3 shows that the lowest mean leaf width was 69 mm found in the C0P0 treatment, namely the treatment with a dose of 0 kg of vermicompost and 0 grams of NPK fertilizer. In addition, the lowest leaf width was also seen in the C2P0 treatment, namely the treatment of 1.6 kg of vermicompost combined with 0 grams of NPK fertilizer. The highest leaf width was found in the treatment of 1.6 kg of vermicompost combined with 1 gram of NPK fertilizer

Analysis of variance gave the result that the different doses of vermicompost had no significant effect on the width of the long bean leaf. Application of NPK fertilizer can increase the leaf width of long beans. The interaction of the application of vermicompost and NPK fertilizer did not significantly affect the leaf width of long beans. The increase in leaf width of the long beans given NPK fertilizer was due to the fact that NPK fertilizer was able to provide sufficient nitrogen, phosphorus and potassium nutrients to increase plant vegetative growth. Lakitan (2007) explains that nitrogen is needed in large quantities by plants to stimulate vegetative growth. Furthermore, Mansyur et al (2021) explained that phosphorus nutrients function as a constituent of nucleic acids, ATP, ADP, constituents of cell nuclei, fats and proteins. Potassium is a nutrient that functions as a catalyst in ion transport, facilitating the process of photosynthesis, and plays a role in the formation of carbohydrates and proteins. Thus the availability of sufficient nitrogen, phosphorus and potassium nutrients can increase vegetative growth including leaf growth.

Long Bean Stem

The length of the long bean stem was measured when the long bean was 30 days old. The amount of vermicompost and NPK fertilizer applied to the growing media can affect the length of the long bean stem. The results of measuring the length of long bean stems vary according to the dose of vermicompost and NPK fertilizer given. In table 4. Data is presented on the average length of long bean stems due to different doses of NPK fertilizer and Vermicompost

Table 4. Mean Stem Length of Long Beans at Different Doses of NPK Fertilizer and Vermicompost

Treatment	Stem Length (cm)	Treatment	Stem Length (cm)
C0P0	120	C2P0	127
C0P1	127	C2P1	128
C0P2	131	C2P2	135
C0P3	129	C2P3	133
C1P0	126	C3P0	127
C1P2	127	C3P1	128
C1P2	134	C3P2	133
C1P3	134	C3P3	130

Table 4 can be observed that the lowest stem length measured when the plant was 30 days old was 120 cm which was found in the C0P0 treatment, namely plants growing on land treated with 0 kg of vermicompost fertilizer and 0 grams of NPK fertilizer. Furthermore, up to a dose of 1.6 kg of vermicompost and 1 g of long bean stem NPK fertilizer increased in line with the increase in the treatment dose of vermicompost and NPK fertilizer. The highest average stem length was 135 cm which was obtained in the C2P2 treatment, namely the application of 1.6 kg of vermicompost combined with 1 g of NPK fertilizer.

The results of the analysis of variance showed that the vermicompost treatment significantly increased the stem length of the long bean. Application of NPK fertilizer can significantly increase the length of long bean stems. The interaction of the dose of vermicompost and NPK fertilizer had no significant effect on the length of the long bean stem. The increase in the length of long bean stems due to the application of vermicompost is possible because vermicompost can increase the amount of nutrients available to plants. The results of the research of Andriawan et al. (2022) show that vermicompost contains nutrients that meet the Indonesian national standard for compost specifications from domestic organic waste. Earthworms fed chicken manure, banana hump and tofu dregs were able to produce vermicompost containing 2.72% nitrogen and 0.80% phosphorus. This content is greater than the minimum content determined by the Indonesian National Standard for compost from organic matter, which is 0.40% nitrogen and 0.10% phosphorus. Furthermore, Walida et al. (2021) reported that vermicompost are shaped like small soil grains. The vermicompost contained 10.55% C-org, 1.07% nitrogen, 0.22% phosphorus, 0.30% potassium, 9.85% C/N. Likewise, Sinda et al. (2015) found that the use of vermicompost on agricultural land can increase soil organic matter, soil pH, available soil phosphorus and soil nitrogen content up to 1,41%. Durak et al (2017) reported that vermicompost was an applicable and beneficial organic matter and nutrient source. In an economical point of view that 300 kg/da vermicompost dosage gave the higgest yield and improved most of the

growth parameter in lettuce pruduction. Kumar and Gupta (2018) concluled that vermicompost is better fertilizers than other fertilizers due to the availabilities of nutrients in vermicompost and also help in sustainability of agricultural sector.

In other studies, it was also found that the application of vermicompost can increase plant growth. The use of vermicompost can stimulate and increase the number of leaves, plant height and fresh weight of mustard greens. In addition, the vermicompost treatment also increased organic C, N-total, C/N ratio and soil pH (Lokha et al., 2021). Laia et al (2021) concluded that the application of vermicompost on oil palm can increase the growth of plant height, number of leaves, leaf length, leaf width and leaf area. The treatment of vermicompost can increase leaf length, leaf width, number of tillers, rhizome length and rhizome weight of red ginger. The optimum dose of vermicompost for red ginger is 150 grams per polybag (Lidar et al., 2021). The height of kale land can be increased by giving vermicompost fertilizer. In addition to stem height, the application of vermicompost can also stimulate an increase in the wet weight and dry weight of kale land plants (Oka, 2007). Giving vermicompost as much as 60 grams can increase plant height, fresh weight and plant dry weight (Pratama et al., 2018).

Conclusion

In accordance with the results of research and data analysis in this study, it can be concluded: (1) The vermicompost treatment significantly increased the number of leaves and plant height, but could not increase the length and width of the long bean leaf, (2) The application of NPK fertilizer could increase the leaf length, width and width of the leaves. leaves, number of leaves and length of long bean stems, (3) the interaction of vermicompost and NPK fertilizer treatments did not significantly affect all parameters of plant growth measured.

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